

What is claimed is:

1. A plasma display apparatus comprising:

a plasma display panel having a substrate, electrodes X1 to Xn+1 formed at said substrate, electrodes Y1 to Yn formed at said substrate and address electrodes formed at said substrate or at another substrate facing said substrate at a distance, said electrodes X1 to Xn+1 being arranged in that order and parallel to one another, an electrode Yi being arranged between an electrode Xi and an electrode Xi+1 for each $i = 1$ to n , said address electrodes being arranged with intersecting said electrodes X1 to Xn+1 and Y1 to Yn at a distance; and

an electrode drive circuit;

wherein said electrode drive circuit includes:

first field addressing means, for $i = 1$ to n , for causing a first address discharge to occur between said electrode Yi and said address electrodes selected in correspondence to display data in a first field of a frame and for causing a discharge to occur between said electrode Yi and said electrode Xi using said first address discharge as a trigger to generate a first wall charge required for a sustaining discharge in correspondence to said display data in said first field;

first field sustaining means, after said first wall charge having been generated and for odd number o among 1 to

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n and for even number e among 1 to n, for supplying a first AC sustaining pulse between an electrode Y_o and an electrode X_o and for supplying a second AC sustaining pulse between an electrode Y_e and an electrode X_e ;

second field addressing means, for $i = 1$ to n, for causing a second address discharge to occur between said electrode Y_i and said address electrodes selected in correspondence to display data in a second field of said frame and for causing a discharge to occur between said electrode Y_i and said electrode X_{i+1} using said second address discharge as a trigger to generate a second wall charge required for a sustaining discharge in correspondence to said display data in said second field; and

second field sustaining means, after said second wall charge having been generated and for odd number o among 1 to n and for even number e among 1 to n, for supplying a third AC sustaining pulse between said electrode Y_o and said electrode X_{o+1} and for supplying a fourth AC sustaining pulse between said electrode Y_e and said electrode X_{e+1} .

2. A plasma display apparatus according to claim 1,

wherein said first field sustaining means supplies said first and second AC sustaining pulses with ensuring that voltage waveforms applied to said electrodes Y_o and X_e are of the same phase to each other, that voltage waveforms

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applied to the electrodes Ye and Xo are of the same phase to each other and that said first and second AC sustaining pulses are of the reverse phase to each other; and

wherein said second field sustaining means supplies said third and fourth AC sustaining pulses with ensuring that voltage waveforms applied to said electrodes Yo and Xo are of the same phase to each other, that voltage waveforms applied to said electrodes Ye and Xe are of the same phase to each other and that said third and fourth AC sustaining pulses are of the reverse phase to each other.

3. A plasma display apparatus according to claim 2, wherein said first field addressing means, in a first period, applies a DC voltage to all odd-numbered electrodes among said electrodes X1 to Xn+1 and applies a pulse with a reverse polarity voltage against said DC voltage to said electrode Yo, and in a second period, applies said DC voltage to all even-numbered electrodes among said electrodes X1 to Xn+1 and applies a pulse with a reverse polarity voltage against said DC voltage to said electrode Ye; and

wherein said second field addressing means, in a third period, applies said DC voltage to all said even-numbered electrodes among said electrodes X1 to Xn+1 and applies a pulse with a reverse polarity voltage against said DC voltage to said electrode Yo, and in a fourth

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period, applies said DC voltage to all said odd-numbered electrodes among said electrodes X1 to Xn+1 and applies a pulse with a reverse polarity voltage against said DC voltage to said electrode Ye.

4. A plasma display apparatus according to claim 2, wherein said first field addressing means apply pulses with reverse polarity voltages to each other to said electrodes Yi and Xi when causing said discharge to occur between said electrode Yi and said electrode Xi; and

wherein said second field addressing means applies pulses with reverse polarity voltages to each other to said electrodes Yi and Xi+1 when causing said discharge to occur between said electrode Yi and said electrode Xi+1.

5. A plasma display apparatus according to claim 2, wherein said first and second field addressing means includes:

a first sustain circuit for outputting a first voltage-waveform of a DC pulse train;

a second sustain circuit for outputting a second voltage-waveform with its phase offset by 180° from a phase of said first voltage-waveform;

a switching circuit having switching elements for selectively supplying either said first or second voltage-waveform to said electrodes Yo, Ye, Xo and Xe; and

a control circuit for controlling said switching

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elements of said switching circuit in such a way that said first voltage-waveform is supplied to said electrodes Yo and Xe and said second voltage-waveform is supplied to said electrodes Ye and Xo after said first wall charge having been generated and that said first voltage-waveform is supplied to said electrodes Yo and Xo and said second voltage-waveform is supplied to said electrodes Ye and Xe after said second wall charge having been generated.

6. A plasma display apparatus according to claim 2, wherein both said first field and said second field consist of a plurality of subfields with numbers of sustaining discharge pulses different from one another, and wherein said electrode drive circuit further comprising:

first field reset means, prior to said first address discharge in a first subfield of said first field and for $i = 1$ to n , for causing a discharge to occur between said electrode Yi and said electrode Xi and between said electrode Yi and said electrode Xi+1 in order to eliminate wall charge for all pixels or to generate wall charge for all pixels; and prior to said first address discharge in the rest subfields of said first field and for odd number o among 1 to n and for even number e among 1 to n , for causing a discharge D1 to occur between said electrode Yo and said electrode Xo and a discharge D2 to occur between said electrode Ye and said electrode Xe with a time lag from said

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discharge D1 in order to eliminate or generate wall charge only for pixels in said first field; and

second field reset means, prior to said second address discharge in a first subfield of said second field and for $i = 1$ to n , for causing a discharge to occur between said electrode Y_i and said electrode X_i and between said electrode Y_i and said electrode X_{i+1} in order to eliminate wall charge for all pixels or to generate wall charge for all pixels; and prior to said second address discharge in the rest subfields of said second field and for odd number o among 1 to n and for even number e among 1 to n , for causing a discharge D3 to occur between said electrode Y_o and said electrode X_{o+1} and a discharge D4 to occur between said electrode Y_e and said electrode X_{e+1} with a time lag from said discharge D3 in order to eliminate or generate wall charge only for pixels in said second field.

7. A plasma display apparatus according to claims 1, wherein each of said electrodes X_1 to X_{n+1} and Y_1 to Y_n includes:

a transparent electrode formed at said substrate;
and

a metal electrode formed at said transparent electrode along the central line of said transparent electrode with a width smaller than said transparent electrode.

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8. A plasma display apparatus comprising:

a plasma display panel having a substrate, electrodes X1 to X2n formed at said substrate, electrodes Y1 to Yn formed at said substrate and address electrodes formed at said substrate or at another substrate facing said substrate at a distance, electrodes X_o, Y_i and X_e being arranged in that order parallel to one another, where $o = 2i - 1$, $e = 2i$ and $i = 1$ to n , said address electrodes being arranged with intersecting said electrodes X1 to X2n and Y1 to Yn at a distance; and

an electrode drive circuit;

wherein said electrode drive circuit includes:

odd-numbered flame addressing means, for $o = 2i - 1$ and $i = 1$ to n , for causing a first address discharge to occur between said electrode Y_i and said address electrodes selected in correspondence to display data in an odd-numbered flame and for causing a discharge to occur between said electrode Y_i and said electrode X_o using said first address discharge as a trigger to generate a first wall charge required for a sustaining discharge in correspondence to said display data in said odd-numbered flame;

odd-numbered flame sustaining means, for $o = 2i - 1$ and $i = 1$ to n , for supplying a first AC sustaining pulse between said electrode Y_i and said electrode Y_o after said

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first wall charge having been generated;

even-numbered flame addressing means, for $e = 2i$ and $i = 1$ to n , for causing a second address discharge to occur between said electrode Y_i and said address electrodes selected in correspondence to display data in an even-numbered flame and for causing a discharge to occur between said electrode Y_i and said electrode X_e using said second address discharge as a trigger to generate a second wall charge required for a sustaining discharge in correspondence to said display data in said even-numbered flame; and

even-numbered flame sustaining means, for $e = 2i$ and $i = 1$ to n , for supplying a second AC sustaining pulse between said electrode Y_i and said electrode Y_e after said second wall charge having been generated.

9. A plasma display apparatus according to claim 8, wherein said electrodes X_o , Y_i and X_e have substantially symmetrical forms relative to a central line of said electrode Y_i ;

wherein each of said electrodes have a transparent electrode formed at said substrate, and a metal electrode formed at said transparent electrode at a width smaller than that of said transparent electrode; and

wherein said metal electrodes of said electrodes X_o and X_e is arranged on sides away from said electrode Y_i .

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10. A plasma display apparatus according to claim 8,
wherein said electrodes Xo, Yi and Xe have
substantially symmetrical forms relative to a central line
of said electrode Yi;

wherein said electrode Yi is a metal electrode
formed at said substrate;

wherein each of said electrode Xo and said electrode
Xe has a transparent electrode formed at said substrate, and
a metal electrode formed at said transparent electrode at a
width smaller than that of said transparent electrode; and

wherein said metal electrodes of said electrodes Xo
and Xe are arranged on sides away from said electrode Yi.

11. A plasma display panel comprising a substrate
sustaining electrodes, for sustaining discharge, formed in
parallel to one another at said substrate and address
electrodes formed at said substrate or at another substrate
facing said substrate at a distance, said address
electrodes being arranged with intersecting said
sustaining electrodes at a distance in parallel to one
another, said plasma display panel further comprising a
light blocking member at a non display line between adjacent
electrodes of said sustaining electrodes.

12. A plasma display panel according to claim 11,
wherein said address electrodes formed at said substrate
are covered with phosphor, and an observer-side surface of

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said light blocking member has darker colour than said phosphor.

13. A plasma display apparatus comprising:

a plasma display panel having a substrate, electrodes X1 to Xn formed at said substrate, electrodes Y1 to Yn formed at said substrate, address electrodes formed at said substrate or at another substrate facing said substrate at a distance and a light blocking member between electrodes Yi and Xi+1, where $i = 1$ to $n-1$, electrodes Xi and Yi being arranged by terns in parallel, where $i = 1$ to n ; and

an electrode drive circuit;

wherein said electrode drive circuit includes:

reset means, for $i = 1$ to $n - 1$, for causing a discharge to occur between said electrode Yi and an electrode Xi+1 with ensuring that voltage waveforms applied to said electrodes Xi and Yi are in the same phase to each other and that voltage waveforms applied to said electrode Xn and said electrode Yn are in the same phase to each other in a reset period;

addressing means, for $i = 1$ to n , for causing an address discharge to occur between either said electrode Xi or Yi and said address electrode selected in correspondence to display data and causes a discharge to occur between said electrode Xi and electrode Yi using said address discharge. as a trigger to generate a wall charge required for a

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sustaining discharge in correspondence to said display data in an address period after said reset period has elapsed; and

sustaining means, for $i = 1$ to n , for supplying an AC sustaining pulse between said electrode X_i and said electrode Y_i in a sustain period after said address period has elapsed.

14. A plasma display panel comprising a substrate, address electrode bundles formed along to one another at said substrate and scanning electrodes, for causing a discharge between said address electrode bundles and said scanning electrodes to generate a wall charge required for a sustaining discharge in correspondence to display data, said scanning electrodes intersecting said address electrode bundles at a distance, wherein each of said address electrode bundles includes:

m ($m \geq 2$) number of address electrodes formed along to one another at said substrate in correspondence to one monochromatic pixel column;

pads arranged along a lengthwise direction of said address electrodes corresponding to each monochromatic pixel, said pads being above said m number of address electrodes relative to said substrate; and

contacts for connecting one pad to one of said address electrodes in a regular manner along said

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lengthwise direction of said address electrodes.

15. A plasma display apparatus comprising:

a plasma display panel including a substrate, address electrode bundles formed along to one another at said substrate and scanning electrodes, for causing a discharge between said address electrode bundles and said scanning electrodes to generate a wall charge required for a sustaining discharge in correspondence to display data, said scanning electrodes intersecting said address electrode bundles at a distance; and

an electrode drive circuit for supplying drive voltages to said electrodes of said plasma display panel in correspondence to display data;

wherein each of said address electrode bundles includes:

m ($m \geq 2$) number of address electrodes formed along to one another at said substrate in correspondence to one monochromatic pixel column;

pads arranged along a lengthwise direction of said address electrodes in correspondence to each monochromatic pixel, said pads being above said m number of address electrodes relative to said substrate; and

contacts for connecting one pad to one of said address electrodes in a regular manner along said lengthwise direction of said address electrodes.

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16. A method of driving a plasma display panel, said plasma display panel having a substrate, electrodes X1 to Xn+1 formed at said substrate, electrodes Y1 to Yn formed at said substrate and address electrodes formed at said substrate or at another substrate facing said substrate at a distance, said electrodes X1 to Xn+1 being arranged in that order and parallel to one another, an electrode Yi being arranged between an electrode Xi and an electrode Xi+1 for each $i = 1$ to n , said address electrodes being arranged with intersecting said electrodes X1 to Xn+1 and Y1 to Yn at a distance, said method comprising the steps of:

(1) for $i = 1$ to n , causing a first address discharge to occur between said electrode Yi and said address electrodes selected in correspondence to display data in a first field of a frame and causing a discharge to occur between said electrode Yi and said electrode Xi using said first address discharge as a trigger to generate a first wall charge required for a sustaining discharge in correspondence to said display data in said first field;

(2) after said first wall charge having been generated and for odd number o among 1 to n and for even number e among 1 to n , supplying a first AC sustaining pulse between an electrode Yo and an electrode Xo and supplying a second AC sustaining pulse between an electrode Ye and an electrode Xe;

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(3) for $i = 1$ to n , causing a second address discharge to occur between said electrode Y_i and said address electrodes selected in correspondence to display data in a second field of said frame and causing a discharge to occur between said electrode Y_i and said electrode X_{i+1} using said second address discharge as a trigger to generate a second wall charge required for a sustaining discharge in correspondence to said display data in said second field; and

(4) after said second wall charge having been generated and for odd number o among 1 to n and for even number e among 1 to n , supplying a third AC sustaining pulse between said electrode Y_o and said electrode X_{o+1} and supplying a fourth AC sustaining pulse between said electrode Y_e and said electrode X_{e+1} .

17. A method according to claim 16,

wherein said step (2), supplying said first and second AC sustaining pulses with ensuring that voltage waveforms applied to said electrodes Y_o and X_e are of the same phase to each other, that voltage waveforms applied to the electrodes Y_e and X_o are of the same phase to each other and that said first and second AC sustaining pulses are of the reverse phase to each other; and

wherein said step (4), supplying said third and fourth AC sustaining pulses with ensuring that voltage

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waveforms applied to said electrodes Y_o and X_o are of the same phase to each other, that voltage waveforms applied to said electrodes Y_e and X_e are of the same phase to each other and that said third and fourth AC sustaining pulses are of the reverse phase to each other.

18. A method of driving a plasma display panel, said plasma display panel having a substrate, electrodes X_1 to X_{2n} formed at said substrate, electrodes Y_1 to Y_n formed at said substrate and address electrodes formed at said substrate or at another substrate facing said substrate at a distance, electrodes X_o , Y_i and X_e being arranged in that order parallel to one another, where $o = 2i - 1$, $e = 2i$ and $i = 1$ to n , said address electrodes being arranged with intersecting said electrodes X_1 to X_{2n} and Y_1 to Y_n at a distance, said method comprising the steps of:

for $o = 2i - 1$ and $i = 1$ to n , causing a first address discharge to occur between said electrode Y_i and said address electrodes selected in correspondence to display data in an odd-numbered frame and causing a discharge to occur between said electrode Y_i and said electrode X_o using said first address discharge as a trigger to generate a first wall charge required for a sustaining discharge in correspondence to said display data in said odd-numbered frame;

for $o = 2i - 1$ and $i = 1$ to n , supplying a first AC

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sustaining pulse between said electrode Y_i and said electrode Y_o after said first wall charge having been generated;

for $e = 2i$ and $i = 1$ to n , causing a second address discharge to occur between said electrode Y_i and said address electrodes selected in correspondence to display data in an even-numbered frame and causing a discharge to occur between said electrode Y_i and said electrode X_e using said second address discharge as a trigger to generate a second wall charge required for a sustaining discharge in correspondence to said display data in said even-numbered frame; and

for $e = 2i$ and $i = 1$ to n , supplying a second AC sustaining pulse between said electrode Y_i and said electrode Y_e after said second wall charge having been generated.

19. A method of driving a plasma display panel, said plasma display panel having a substrate, electrodes X_1 to X_n formed at said substrate, electrodes Y_1 to Y_n formed at said substrate, address electrodes formed at said substrate or at another substrate facing said substrate at a distance and a light blocking member between electrodes Y_i and X_{i+1} , where $i = 1$ to $n-1$, electrodes X_i and Y_i being arranged by turns in parallel, where $i = 1$ to n , said method comprising the steps of:

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for $i = 1$ to $n - 1$, causing a discharge to occur between said electrode Y_i and an electrode X_{i+1} with ensuring that voltage waveforms applied to said electrodes X_i and Y_i are in the same phase to each other and that voltage waveforms applied to said electrode X_n and said electrode Y_n are in the same phase to each other in a reset period;

for $i = 1$ to n , causing an address discharge to occur between either said electrode X_i or Y_i and said address electrode selected in correspondence to display data and causes a discharge to occur between said electrode X_i and electrode Y_i using said address discharge as a trigger to generate a wall charge required for a sustaining discharge in correspondence to said display data in an address period after said reset period has elapsed; and

for $i = 1$ to n , supplying an AC sustaining pulse between said electrode X_i and said electrode Y_i in a sustain period after said address period has elapsed.

20. A method of driving a plasma display panel, said plasma display panel having a substrate, address electrode bundles formed along to one another at said substrate and scanning electrodes, for causing a discharge between said address electrode bundles and said scanning electrodes to generate a wall charge required for a sustaining discharge, in correspondence to display data, said scanning electrodes

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intersecting said address electrode bundles at a distance,
wherein each of said address electrode bundles
includes: m ($m \geq 2$) number of address electrodes formed
along to one another at said substrate in correspondence to
one monochromatic pixel column; pads arranged along a
lengthwise direction of said address electrodes
corresponding to each monochromatic pixel, said pads being
above said m number of address electrodes relative to said
substrate; and contacts for connecting one pad to one of
said address electrodes in a regular manner along said
lengthwise direction of said address electrodes;

said method comprising the steps of:

selecting simultaneously m number of said scanning
electrodes facing said pads connected to said m number of
address electrodes; and

applying voltages corresponding to display data to
said m number of address electrodes simultaneously;

whereby scanning of said scanning electrodes is
executed in units of m lines.

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